JANUARY 21, 1985
CHEMICAL & ENGINEERING
NEWS

Carbide chairman Anderson explains post-Bhopal strategy
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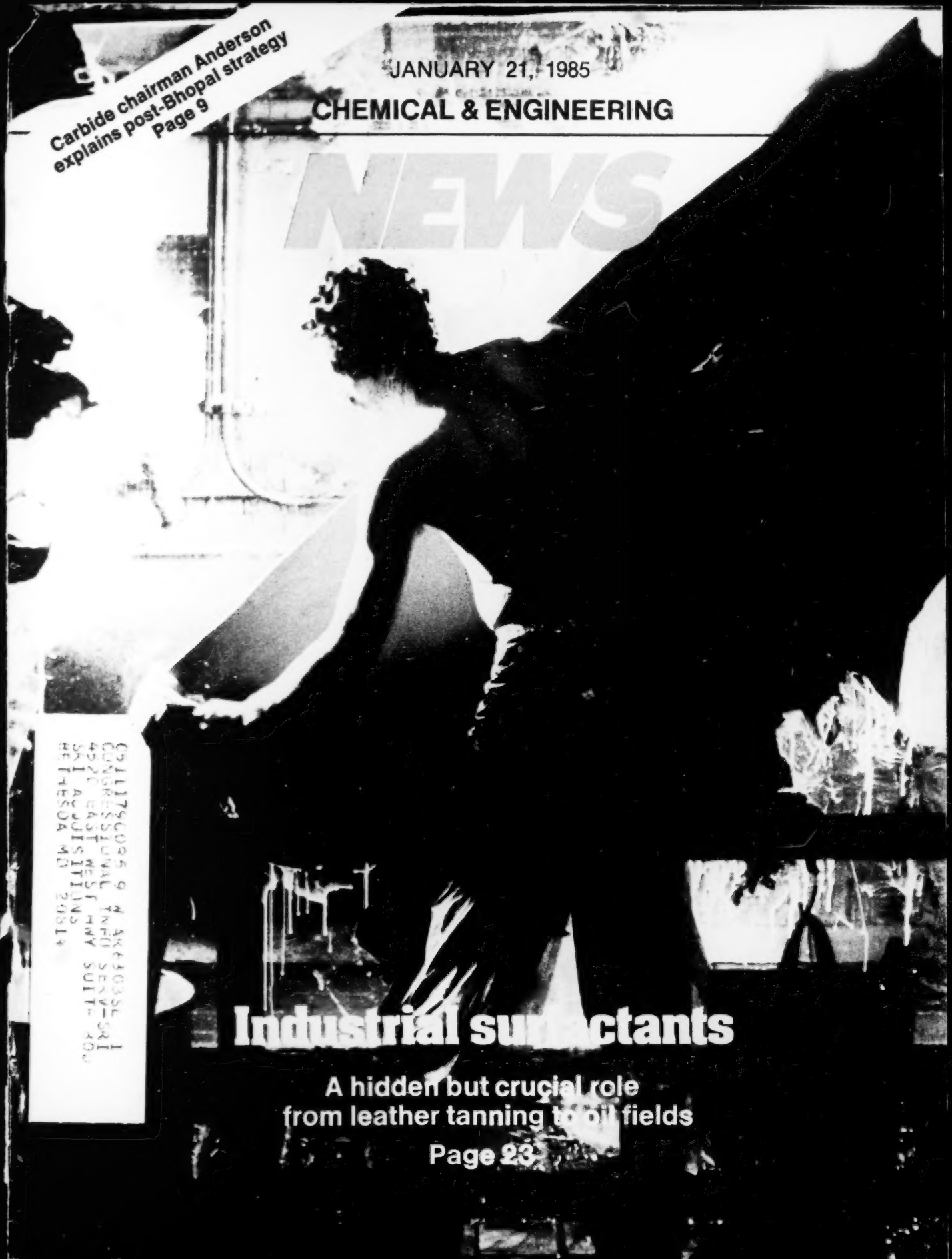

Industrial surfactants

A hidden but crucial role from leather tanning to oil fields

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JANUARY 21, 1985

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Cover: Leather processing, shown here in Argentina, is one of myriad outlets for industrial surfactants. Photo courtesy of BASF America

Product Report

Industrial surfactants producers see substantial growth ahead in areas such as oil fields, fibers, pesticides, and slurries. **Page 23**

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Industrial Surfactants Set for Strong Growth

BASF Wyandotte photo

Oil fields are biggest market for industrial surfactants used for froths, well stimulants, demulsifiers, enhanced recovery

Patricia L. Layman, C&EN London

Where there is foamy lather, there usually is a surfactant. But does it follow that if there are no bubbles and foam, there are no surfactants? Not with industrial surfactants, where some specifications for the compounds even require foam suppression. For industrial surfactants, instead, the role is that of a usually hidden—but crucial—facilitator.

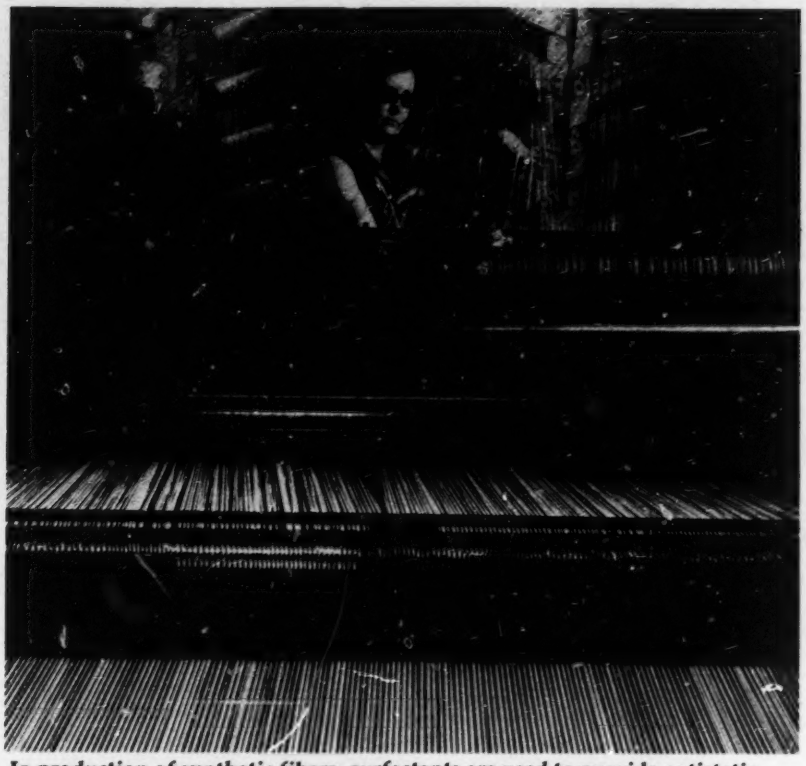
For such surfactants, the markets are quite different from those of their household-detergent brethren, used in commodity quantities in a handful of well-defined and well-tracked end uses, made by a relatively small number of large chemical suppliers. For industrial surfactants, instead, there is a plethora of ill-defined, fragmented markets, which use small quantities of surfactants—sometimes down to the parts-per-million level—and supplied by a host of companies ranging from the giants to the very small specialty outfits.

Industrial surfactants find their way into a vast number of industries. In fact, as one marketer puts it, there is no industry that doesn't use surfactants; they all do, to some extent. The industries can be as prosaic as asphalt manufacturing or as exotic as building antisoiling properties into carpet fibers. They can be as large as petroleum production and additives, which are a nearly 800 million lb-per-year market in the U.S., to the smaller, such as the 50 million or so lb-per-year market for surfactants used in the leather and fur processing industries.

Although a large percentage of the industrial surfactant field consists of lower-priced commodity surfactants, such as the lignosulfonates, which help bring down the overall value of the business, a number of specialty surfactants still are capable of earning respectable prices and profits.

In fact, the industrial surfactants business has a healthier growth rate in sight than does its counterpart household-detergent surfactants industry. That industry closely tracks population growth and the growth in gross national product, and probably will grow 2 to 3% per year over the next few years. Demand for industrial surfactants, on the other hand, may well grow 4 to 5% per year over the same period, with some segments shooting up 10% per year or more.

North American industrial markets consumed some 3.6 billion lb or so of surfactants in 1983, according to Colin A. Houston, president of the



In production of synthetic fibers, surfactants are used to provide antistatic properties as well as processing lubricity

consulting company Colin A. Houston & Associates, who in 1983 completed a survey on surfactants in industrial applications in the U.S., Canada, and Mexico. At that time, he predicted growth of only 2.9% per year to reach annual consumption of 4.4 billion lb in 1990.

The relatively mature U.S. and Canadian markets were slated for a 2.5%-per-year growth. Mexican markets, still developing, would grow at more than 10% per year, Houston predicted. (Those figures all include institutional and industrial cleaners—the so-called "I and I" market for formulated janitorial, sanitation, and similar cleaners—which this report does not cover. The "I and I" business is generally reckoned at about 15 to 16% of total industrial surfactant consumption.)

With the North American market for industrial surfactants well on its way to more than 4 billion lb by 1990, Houston has turned his eyes to Western Europe, looking at the counterpart market. In many ways, market research in Europe is more difficult than in the U.S. or even in the North American continent. One of the first decisions, for example, is which countries will be included, just the European Economic Community countries, or all non-Eastern bloc countries? For a survey on industrial surfactants, will the researcher include lignosulfonates, the predominant U.S. material? If so, the figures won't agree with those of West German market researchers, who rather haughtily dismiss lignosulfonates from the ranks of true surfactants. Similar other discrepancies dog the studious market researcher.

However, from data from Shell Chemical, presented at the world Surfactants Congress in Munich last May, it would appear that Western European consumption of industrial surfactants is about half that of the U.S.—576,000 metric tons per year, as compared with about 1.26 million metric tons in the U.S. estimated for this year.

In part, consumption is larger in the U.S. because a number of markets using industrial surfactants in the U.S. are more highly developed than in Europe. For example, mining as an end use for surfactants is more highly developed in the U.S., if for no other reason than that more mining is done in the U.S. than in Europe. And in the petroleum industry, nearly all U.S. oil companies are highly sophisticated when it comes to using surfactants in oil production, one European surfactants marketer says. In Europe, however, only two are: Royal/Dutch Shell, the Anglo-Dutch company; and British Petroleum. The others do little R&D into surfactant applications.

And R&D is what counts in the industrial surfactants business. There are a few industrial end uses in which surfactants are used for their traditional laundering and washing characteristics—textile processing, for example, and leather and fur processing. More commonly, however, surfactants function as processing chemicals, additives in the industrial process itself.

As such, they are aids to saving energy, for example, the activation energy of polymerization by micelle formation; the milling energy for pigments by dispersion of the particles and prevention of their reagglomeration; the wetting and spreading energy of reducing the surface tension of coatings. Moreover, they save on the dissipation energy for electrical charges of fibers by lowering the electrical resistance of fiber surfaces.

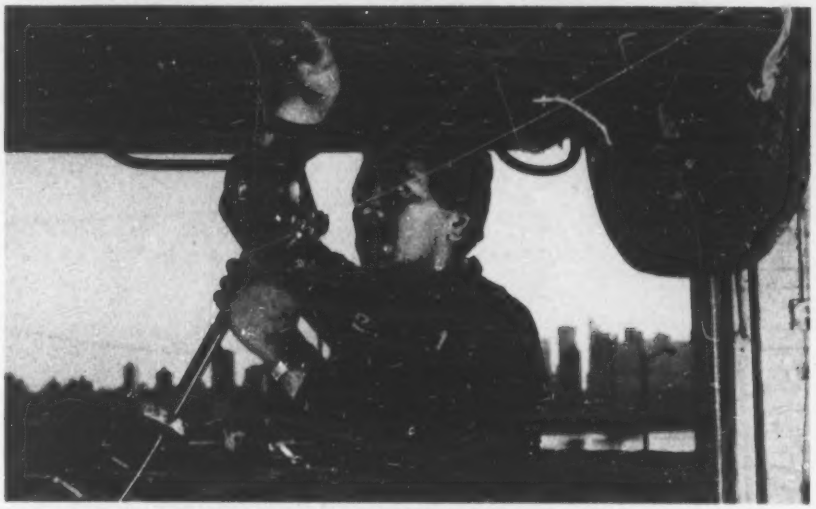
Most of the R&D pertinent to industrial surfactants, then, is aimed at the processes themselves, not surfactants. For a surfactant to be accepted into use, it must fit itself into the process. That usually means surfactants tailor-made or adapted to solve the specific need in the process, or special blends of surfactants that can do the job. Few companies can afford to become expert in all the end-use markets that industrial surfactants are sold into, a number that one marketer says seems on hectic days in particular to be in the thousands. Realistically, companies have to put some limit on their efforts.

In some cases, particularly the larger, multichemical-product-line companies, the strategy is to know thoroughly the properties of the surfactants offered. In many cases, that suffices for a company's technical-service and R&D people to work with customers to design products they need. In other cases, though, the

company will have experts on the markets themselves, working to develop new applications.

Even within one end-use market, different surfactants may be required. For example, within the textile processing industry, there will be a need for phosphate esters for lubrication, blends of surfactants for dye-carrier emulsification, special surfactants for mercerization, and still others for aiding dye penetration.

Compounding a supplier's problem is that when surfactants are crucial enough to a process and if the buyer is large enough, the buyer may well have captive surfactant operations. It's not unusual in the textile industry, for example, for large textile producers to have captive surfactant production.



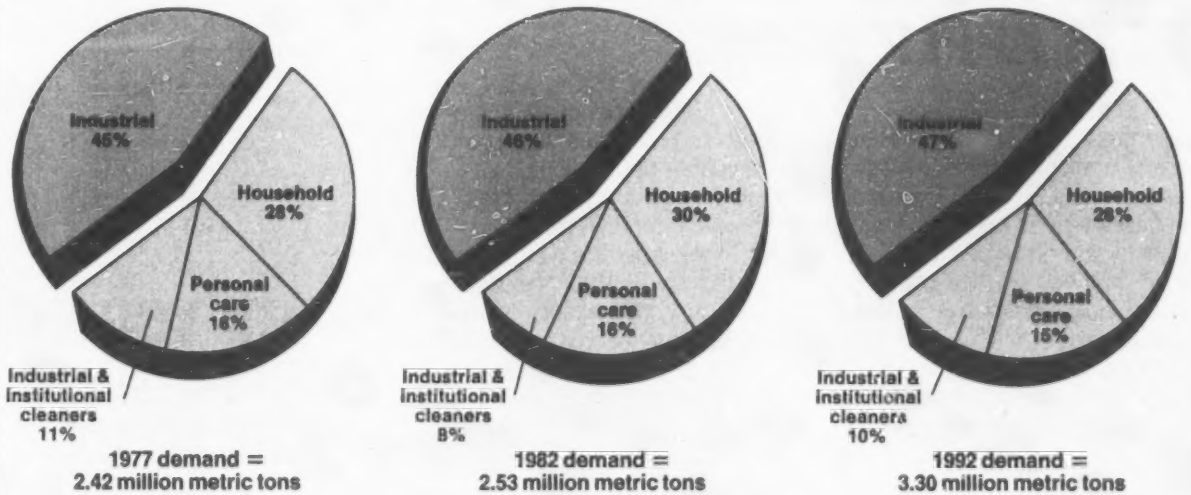
Surfactants incorporated into lube-oil additives give detergency and provide sludge dispersion for motor vehicle lubricants

That helps point out the two-tiered nature of the markets that industrial surfactants are sold into. Especially in Western Europe but also in the U.S., large customers—for instance, in plastics and paint processing or agricultural chemicals—are also surfactant producers. This is where the R&D is done, in the big companies, says one surfactants producer. The large companies develop their own systems and processes, using the surfactants they already sell. That makes it difficult for new suppliers to get in. Besides, if processors change one product in the system, they must often change the entire system, resulting in another hurdle for merchant suppliers.

On the other hand, smaller companies don't have such extensive R&D backup in-house, so they rely on the surfactant supplier. Reports one business development specialist, "You can be selling somebody a highly specialized surfactant for their process, and the guy at the plant will just call up and say, 'Send some more soap.'" Such customers couldn't care less about what the surfactant is: what its chemistry is, how it works, and so on. All that matters is whether it works to the specifications in the process.

In many of these areas, then, selling to the industrial surfactants industry becomes the task of selling to the classic chemical specialty business. Not only must suppliers know what the customer needs, they must know how the customer works with a process and what is important to the customer in the process. Suppliers must, therefore, be willing to work with their customers to find out how they work, then go back to the lab to do the same kind of testing, so they can come back to demonstrate

Industrial surfactants will slowly increase their share of U.S. surfactant market by 1992



Source: Shell Chemical

CIRCLE 28 ON READER SERVICE CARD

the same kind of functionality the customers need.

That is also one of the major differences between selling to the industrial surfactant users and selling to the household detergent industry. As expert and smart as surfactant suppliers can be, for example, there is little about surfactant chemistry and functioning that they can tell customers like Procter & Gamble, Colgate-Palmolive, Henkel, or Kao Soap, who all live and breathe detergents.

Dealing with those kinds of customers, it is sales representative to purchasing agent. In the industrial surfactants business, however, far more commonly, it is chemist to chemist, or engineer to engineer. At that level, a chemist can better evaluate, require a bit of fine-tuning, a bit more work, to solve the customer's specific problem.

Such problem solving often can involve confidentiality, and that places the burden of integrity on a supplier. "If the customer defines his problem and we solve it, we can't take this information to other customers," says one marketer. "It's his secret. That means we have to be careful about our commitments. Is that sale large enough to make up for others that we would lose in the same field?"

Again, that is a major difference between industrial and household-detergent surfactants. Far from having to worry about confidentiality and customers' proprietary knowledge, when suppliers are selling to the household detergent industry, they frequently don't know precisely how their material is being used.

That's not the kind of marketing that pleases industrial-surfactant suppliers, however. It's much more profitable to seek out new areas in which supplier expertise can be a valuable addition to the business. The trick is merely to figure out which market areas those are.

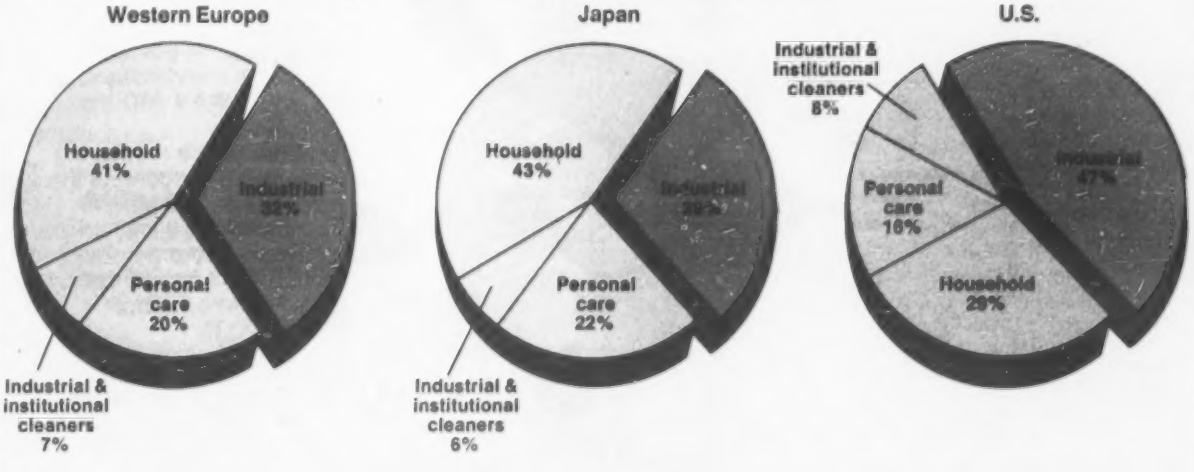
One method to do that is formal establishment of a business development unit, charged with identifying market areas both new and new for the company. Northfield, Ill.-based Stepan Chemical, for example, took that tack as part of a regrouping into business teams several years ago. By 1983 it had its eye on three areas, which have since expanded beyond the pilot-testing stage: surfactant additives for concrete admixtures, surfactant-based foams for oil field service companies, and wetting and foaming agents for use in dust and particulate suppression.

Akzo Chemie wound up on a slightly different tack, almost by accident. The Dutch chemical company had specialized in surfactants for cosmetics almost exclusively, but eventually identified as part of its in-house expertise the technology to formulate a metal cleaner for low-temperature degreasing. That was a departure from previous practice, and the company now is marketing the product as a finished formulation, rather than merely a surfactant for someone else to formulate with. It opened up a new marketing area.

Surfactant suppliers historically have been careful to avoid entering markets also supplied by their customers, to avoid conflicts. But for Akzo, metal degreasing was a far cry from the personal-care field it had been supplying, so the company felt it would be stepping on no toes (at least of its own customers) by entering the business.

The point eventually reached, however, is the need for companies to work out special uses for special customers, as one marketer puts it. A company has to take on such an effort if it wants to find the growth and profits that bypass commodities. No longer can suppliers who are serious about the business afford to rest on their laurels. The business too quickly becomes full of me-too surfactants competing on price, not performance. In as little as two years, a proper specialty surfactant can have multiple suppliers, selling on price, one estimate goes. That leads to price deterioration, and to increasing

Industrial markets take big share of western surfactant production


Western Europe
Household 41%
Industrial 32%
Personal care 20%
Industrial & institutional cleaners 7%
1985 production = 1.78 million to 1.8 million metric tons
Japan
Household 43%
Personal care 22%
Industrial & institutional cleaners 6%
1985 production = 650,000 to 660,000 metric tons
U.S.
Industrial & institutional cleaners 8%
Personal care 16%
Household 29%
1985 production = 2.65 million to 2.7 million metric tons

Sources: Shell Chemical, C&EN estimates

BASF Wyandotte photo

In pesticides, surfactants dilute and disperse active compounds and wet leaves of plants to achieve best penetration of pesticide

pressures for controlling production and distribution costs, and about that time, suppliers are selling commodities.

It doesn't always take fancy R&D to do well with industrial surfactants. Sometimes companies find that, by controlling their own processing conditions, they can improve batch-to-batch responsibility, and earn a higher price for better-quality surfactants. Then, it becomes a matter of convincing the customer that better quality is worth the price. Marketers joke a bit about a "convincibility" index, of which end-use industries go for performance, and which stick on price.

The key seems to be how integral a part in the process the surfactant plays. The more crucial the surfactant, and the better-quality end product the customer can produce, the more that customer is apt to be convinced that the higher price is worth it; the volume used surprisingly doesn't always count.

Petroleum-industry surfactants are far and away the largest end-use market in this business, both for producing petroleum and for incorporating into oil formulations—oil additive packages, lubes and greases, and so on. At 700 million to 800 million lb per year in the U.S., such surfactants are just part of a worldwide oil-field chemicals-and-service business worth $9.3 billion in 1982, according to consultant Houston. Most of that is in North America, but non-North American business was 37% of the total, and growing in importance—an indication that surfactants for oil-field use will be growing, as well.

For several years, the end use of enhanced oil recovery has held out to surfactant suppliers the promise of vast, untold sales. Forecasters' crystal balls frequently took on the colors of fairy-tale riches. And most industry observers agree that if and when the market takes off, it will be wish fulfillment for the industry.

But for the time being, crude oil prices are down, and few producers have projects coming up. Stepan, for one, noted in its annual report for 1983 that the "significant declines in sales and earnings for petroleum sulfonates from our enhanced oil recovery business were caused by the completion of two major contracts and the lower level of crude oil prices."

However, consultant Houston sees production and consumption in the world oil industry starting to increase and by the end of next year demand balancing production.

Enhanced—or tertiary—recovery isn't strictly surfactant, suppliers concede. They must compete with carbon dioxide technology, for example. And they must live with predictions such as those of Shell UK, which, speaking about North Sea oil, recently was quoted in British newspapers as saying that a barrel of oil produced by enhanced recovery methods could be up to 100 times more expensive than normal.

However, according to Donald E. Haupt, manager of the detergents department at Shell Chemical, at the Munich conference in May, "Although the recently favorable crude oil supply situation probably has led to a delay in the time when [enhanced oil recovery] will be employed on a large scale, the real questions are 'when' and 'what kind' of effort will be needed—not 'whether.'"

In the meantime, surfactant suppliers concentrate on their role as an adjunct to the service companies, which take surfactants and formulate them into whatever various compounds they use. Typical uses are

Suppliers range from giants to small specialty firms

With the household detergent industry, such large quantities of surfactants are demanded that, by and large, it's a big-boys' business. Major suppliers of detergent intermediates include such chemical giants as Vista Chemical, Shell Chemical, Monsanto, Chimica Augusta, Petresa, and Ethyl (C&EN, Jan. 23, 1984, page 17).

For supplying industrial surfactants, the roster changes dramatically. To some extent, giants such as Shell and Chimica Augusta do supply the business. But even as they are tracking markets, those large producers manage to give the impression that they feel frustrated by the small size of the markets.

Instead, the major suppliers are companies such as Rohm & Haas, Witco Chemical, Stepan Chemical, GAF, DeSoto, and—one of the few giants keenly supplying the industry—Union Carbide. Henkel, BASF, Akzo Chemie, and Hoechst are active suppliers on both sides of the Atlantic. Many other companies are in the business, such as Onyx, Lonza, Pilot Chemical, and Mona Industries. Du Pont and 3M are particularly active with their specialty fluorosurfactants; American Cyanamid has strength in supplying the mining industry. Jordan Chemical started out as a supplier to the textile industry, almost exclusively, and has since branched out.

high-density froths to bring up drilling matter and water from formations, surfactants to stimulate wells, and demulsifiers to break contaminant water out of the oil as it is brought up before it is refined. Secondary recovery, using water flooding, also offers markets for surfactants, which provide corrosion inhibition and surface wetting to allow water to penetrate the formation.

Surfactants are incorporated into petroleum compounds such as lube-oil additive packages. They give detergency and provide sludge dispersion not just for lubricants for motor vehicles but for other oils, such as cutting oils, and similar other processing oils and lubricants.

Emulsion polymerization is probably the second largest market for industrial surfactants. Emulsions bound for paints, paper coatings, industrial coatings, and emulsified monomers for polymerization all depend upon the surfactants in the formulation. In fact, according to industry marketers, this is one of the most sophisticated fields they sell into, in terms of the quality and performance demanded of surfactants. The surfactants become an integral part of the formulation, and at least one marketer becomes rather indignant at the term "processing aids." "Emulsifiers are not processing aids, they are additives for the product," he argues.

The point is to put into water some materials that are insoluble in water. Monomers can be solubilized, so they can polymerize in an aqueous solution to form latexes for various paints, coatings, and binders. The surfactants used in this application are largely anionics, although some nonionics are used. And it is in the emulsion-dispersion of synthetic rubber that soap finds one of its major industrial applications.

Surfactants now are used at concentrations of about 4% ± 1.5%. There is a trend toward using less material, because customers fear that surfactants can impart some undesirable properties to latex mixes, such as adversely affecting the stability of the latex, for example. And there is significant research being done on building surfactant functionality into a monomer—no surfactant per se, but formulating the monomer with the functionality built into the molecule so the resulting polymer will have surfactant properties.

According to some marketers, the surfactants that a processor chooses can be the key ingredient in the quality of the emulsion. "The monomer and water for the system are both very pure," says one marketer, "so the surfactant becomes important for the quality. Customers push us to make better-quality surfactants, and they give us a premium for this higher quality." This drive, he adds, has been especially strong in the past three or four years.

Surfactants for asphalt and cement are a well-established old market, with a surprising amount of R&D and new-product activity bubbling up. On the cement/concrete side, surfactants serve as air-entraining agents to help control the air-bubble size and spacings. Surfactants also help make workable concrete more flowable, easier to use. (They already have assisted in production of the mix, as grinding aids.)

As plasticizers, the surfactants can reduce the amount of water needed in the concrete formulation, yet still retain the fluidity needed, and, at the same time, have greater strength. Typical use rate is somewhere in a range of 1 oz to 1 lb per 100 lb of cement in the formula.

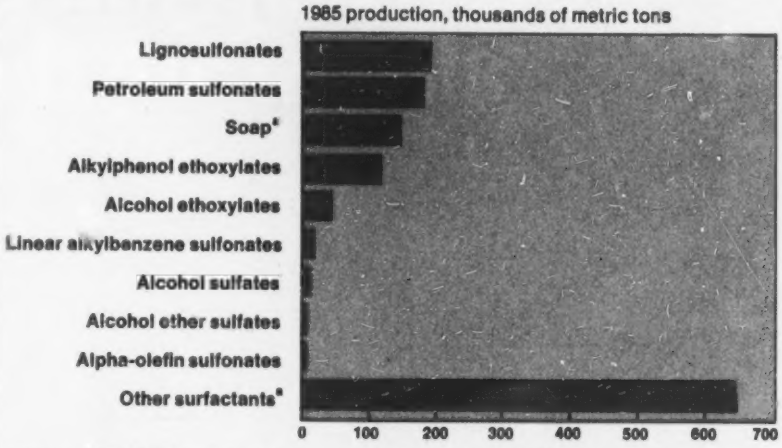
A casual observer might think that for such a commodity-type end use the demand would be for lowest-possible-cost surfactants. But suppliers say there has been a demand lately for improvements in concrete. "When a formulator is using a surfactant to gain fluidity, it can save on labor costs, which can more than [offset] surfactant costs," reports one supplier. "There are many more costs than just raw materials costs, which actually tend to fade in importance."

Surfactants also are competing for the developing market for cellular concrete, used for its barrier properties against, for example, heat or sound. Its lightweight, cellular structure could be obtained by using blowing agents, or the producer could use surfactants for producing the foam incorporated into the structure.

Surfactants used for concrete can be anionic or cationic types; the selection frequently depends upon the nature of the aggregate in the mix. Limestone aggregate, for example, takes anionics; granitic aggregate, cationics.

Cationic amines, though, are the primary beneficiary for the latest revolution in asphaltic emulsions. As environmental pressures nudge users away from solvent-carried asphalt, which must be heated for use during which time solvent vapors are given off, cold-setting asphalts are gaining in popularity. That's especially true for asphalt repairs. The

Lignosulfonates, petroleum sulfonates dominate U.S. industrial surfactant output



a Includes industrial and institutional cleaners. **Sources:** Shell Chemical, C&EN estimates

cold-setting formulations allow relatively quick and easy application. This, then, is one of the "respectably" growing markets for industrial surfactants identified for the remainder of the 1980s. When added to the market for "superplasticizers" in concrete that consultant Houston picks out specifically as growing faster than all other plasticizers during the same period, the prosaic world of cement and concrete takes on a more glamorous aura.

Textile processing and fiber manufacture are two completely different markets, suppliers say, when it comes to sophistication of demand and need for surfactants. The textile side tends to be very commodity oriented, using heavily from the commodity side of alkylphenol ethoxylates and alcohol ethoxylates. These materials have been used for years, are low in price, and are not very specialized.

Their major function is to remove processing oils, scour the textiles, and so on—more or less classical surfactant/detergent functioning. Newer textile technology, however, is putting increasing demands on the surfactants used. For example, during high-temperature scouring, suppliers say, nonionics might deposit onto the fibers being scoured, exhausting the surfactant in the wash bath. Anionics, on the other hand, rinse freely, and last longer in the bath concentration.

On the other hand, high-speed processing increases the need for good antistatic properties, so textile makers would prefer nonionic surfactants, which can contribute those properties.

Much more specialty oriented is the fibers side of the industry, or perhaps chemically oriented is a better description. Compared with textile manufacturers, who don't necessarily have to worry about the chemistry of a surfactant but only that it will work, fiber makers are more demanding of their surfactants. That's not surprising, however, given the limited number of fiber makers and their chemical background. It is also, suppliers grumble, far more secretive than textile manufacturing.

Antistatic compounds are especially important—typically phosphate esters, with a few others for selected applications such as fine-denier nylons.

And processing lubricity is another important function. BASF Wyandotte, for one, is busy developing the market for its block copolymers—ethylene oxide-propylene oxide copolymers—for this application because, the company says, these special nonionics function well at the high speeds in fiber production. The processes are so fast, they generate temperatures occasionally reaching 200 °C. Most of the older-generation surfactants, under those temperatures, would burn off the fibers with a smoky discharge, leaving a gummy residue. The residue could adversely affect the machinery, causing fiber breakage and downtime. The block copolymers burn off cleanly, with no residue.

Depending upon the fiber and upon how much lubricity is needed, from 0.5 to 3.0% of finish solution is added onto the fiber. The solution

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Petroleum uses lead U.S. industrial surfactant market

Millions of lb per year[a]

Petroleum production, additives	750
Plastics processing	313
Asphalt/cement	300
Textiles processing	250
Paints	150
Pulp, paper processing	125
Agricultural chemicals	100

a On a 100%-active basis. Source: Colin A. Houston & Associates

typically contains 30% active surfactant compound.

Performance, suppliers add, is all-important in this application. "The fibers industry is very manufacturing-driven," says one. "The emphasis is on getting the material out. If they find something that works, they'll stay with it." But conversely, adds another supplier, to introduce a new surfactant can take years. There is so much risk for the fibers maker in modifying a process that already works well.

Agricultural chemicals are an end use of growing importance for industrial surfactants. They play two functions: to dilute and disperse pesticide compounds, and to wet the leaves of the plants, for achieving the best penetration of pesticide, which can include insecticides, herbicides, and fungicides.

There are many different forms of pesticides, of course—liquids, powders, and so on. Some contain water and some solvents, but the current trends seem to be taking the industry in the direction of aqueous systems. That's a problem when many of the active compounds in pesticides are not soluble in water.

Pesticides are being made in more and more concentrated forms by manufacturers—too concentrated to use as is. Blends of anionics and nonionics, or single-class surfactants come into play, to emulsify the dilutions. That way, when the dilutions are added to water, they will mix readily and can produce a homogeneous spray. Surfactants are typically 5 to 10% by weight of a pesticide product; suppliers sell directly to the manufacturer, who formulates various strengths for the market.

NEW INTEROX BLEACH SYSTEMS TO MEET CHANGING U.S. NEEDS

Interox today is the largest supplier of peroxygen chemicals to the international detergent industry. Basic in hydrogen peroxide manufacture, Interox produces the widest range of peroxygen derivatives including sodium perborates and percarbonates, persulfates, organic peroxides, organic and inorganic peroxyacids and their salts, and inorganic peroxides. This broad product technology base allows faster upgrading of existing products and the development of new materials to meet the customer's changing needs.

Industry's Changing Needs

Changing wash conditions, new fibers and finishes and the lowering of wash temperatures require modifications of existing bleach products and provide an opportunity for developing innovative new product concepts.

- As the market moved toward the concept of faster-dissolving persalts, Interox developed a form of sodium perborate monohydrate for the detergent bleach market which can be handled without attrition but which retains the desirable attributes of high available oxygen, rapid dissolution rate, and low bulk density.
- Interox America built a new Texas facility which employed an advanced, proprietary fluid bed-technique to make sodium percarbonate. The end product has the physical and chemical property combination required for the fabric-safe-bleach concentrate market.
- Peroxyacids, while recognized for their excellent low-temperature bleach performance, are also notorious for their relatively poor stability in formulations. Interox research, addressed toward developing peroxyacids which can provide fabric-safe bleaching, led to the invention of the lower-temperature highly stable peroxyacid, Interox H48. It is the first of a new generation of safer organic peroxy bleaches for the detergent industry.
- Peroxyacid bleaching systems formed in situ from an activated persalt are an alternative to preformed peroxyacids added to a formulation. Already used in Europe, activated persalts are good low-temperature bleaches. The rate at which the peroxyacid is delivered to the wash, and the efficiency of the peracid generated, is more critical under U.S. conditions. Interox has invented a number of developmental activators and activated bleach systems which can release the peracid, in situ, extremely rapidly.

Commitment to the U.S. Detergent Industry

Worldwide, the Interox Group invests major resources in the development of peroxygen products and systems to serve the detergent manufacturer. Understanding industry's different needs across the world makes the Interox Group unique in its ability to provide coordinated development and technical assistance.

In the last six years Interox has advanced performance of four existing products and built two new plants —one for a unique organic peroxyacid salt, and one for an inorganic peroxyacid salt.

Interox America has manufacturing facilities, laboratory specialists, and industry managers dedicated to serving the U.S. detergent industry. As peroxygens are our only product, you are assured of our commitment to serve your bleaching technology needs. Please call us for assistance in your custom program development or for any of the many facets of service you may require for your bleach needs.

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Similarly, surfactants assist the production of water-dispersible granules, which carry high amounts of pesticide active compounds into the package. The water-dispersible granules help eliminate dusting—no dusty particles are floating around to pose health problems to factory workers or consumers. For these, surfactants are 2 to 4% by weight of the system.

Nonionics assist with emulsion and dispersion; anionics also improve surface wettability and formulation stability. Which surfactants are used depends on which active compounds, in what form, and at what concentration are involved. Suppliers say this is one of the most highly tailored end-use markets they sell to.

Other end-use applications are smaller, but important nonetheless. They include:

• Metal treatment, for pre-, during, and post- whatever operations are being carried out on the metal substrate. The surfactants solubilize the soils present on the metal and disperse them as they are removed. Among the performance-affecting factors are the pH of the bath, the water hardness, the variety of soil types, and whether foam is desired.

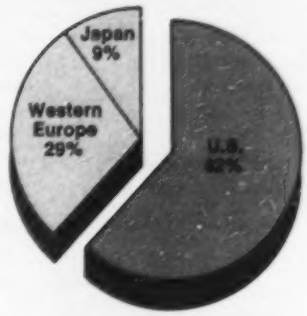
• Defoamers, for wherever foam is not desired. Most of the market presently is made up of specialty silicone defoaming agents, not surfactants. But marketers think there is a small but healthy demand for defoamers that also happen to have surfactant functionality. The formulating might be somewhat easier for a system that also has other surfactants. Use could range from 0.1 to 10%—not surprising given the literally thousands of different applications and variations requiring defoamers.

• Mining, for ore flotation and mineral beneficiation. Minerals adsorb on surfactant froth bubbles, to collect at the top of a bath. They can then be collected as an enriched yield from what normally would have been obtained. Conversely, proper selection of surfactants also can be used to suppress minerals one doesn't want to float. The surfactants are highly tailored, specific for each mineral, although some formulations will work generally on ore groups. For example, xanthates would be used to beneficiate sulfide ores. Cationics, on the other hand, would be used for nonmetallic ores such as potash and silica. The use range depends on the mineral. For example, for copper, which runs 0.6 to 0.8% of the ore, a surfactant might be included at 0.02 to 0.05 lb per ton of ore. For nonmetallics, which frequently make up 50 to 75% of the ore, surfactants would be used at 1 to 2 lb per ton of ore. The U.S. market for mining/ore flotation surfactants at present is depressed, reflecting the state of health of the industry itself. However, marketers say that it is highly active in developing countries, and that this application for surfactants definitely is growing.

• Dust control, for suppressing particulate, airborne pollution. Catching the sometimes ill wind of governmental regulations, suppliers of industrial surfactants are working to develop systems to suppress dust and other airborne particulate pollution in the workplace. The Occupational Safety & Health Administration is encouraging such dust suppression, so there is a market opening up. How long it will continue, or how fast it will grow will depend upon governmental regulations, speed of decisions, and strictness of enforcement, of course. But for the time being, it offers an attractive market, with at least one company saying that its sales into this segment tripled from 1983 to 1984.

• Paper processing, primarily

U.S. uses more surfactants than Europe and Japan



Total 1985 demand = 2.03 million metric tons[a]

a Industrial surfactants.
Sources: Shell Chemical, C&EN estimates

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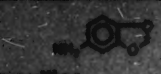
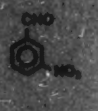


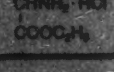
3,4-Methylenedioxyaniline and N-Ethyl-3,4-methylenedioxyaniline



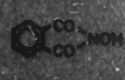
3-Nitrobenzaldehyde

Nitroterephthalic acid dimethyl ester

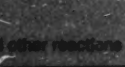
2-Ethylaniline



Aminomalonic acid diethyl ester
Acetylaminomalonic acid diethyl ester



N-Hydroxyphthalimide



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deinking surfactants, and desizers. Both tend to be commodity applications, not highly sophisticated markets.

• Water treatment, primarily for corrosion inhibition. Increasingly important for cooling water systems wherever large quantities of water are used—for example, in oil-field chemicals, the pulp and paper industry, and the chemical industry—these surfactants are particularly fast-growing, says consultant Houston. Typically used are cationics and polyacrylamides.

• Wood preservation, another specialty market for cationic surfactants, which involves temporary or low-level protection of wood. Suppliers are quick to concede that the surfactants are not so effective as materials such as pentachlorophenol, and would not work for difficult tasks, such as total wood impregnation. But they point out that their surfactants are relatively "innocent" in the environment, much more so than the chlorinated organics. They are being used increasingly where they are able to meet the demands: for example, protecting wood when it is being transported from mill to user.

• Antisoiling agents for carpets. These are generally fluorosurfactants, which Houston pegs as showing "extraordinary growth," adding that this "high-unit-price market is expected to reach $40 million by 1985," in North America.

• Coal slurries, a potentially important end use slowly evolving in the U.S. Surfactant technology developed for coal slurry transport also could be modified for transport of other materials. The market is expected to increase dramatically over the next few years. One optimistic prediction holds that the market may reach 200 million lb by 1990.

Regardless of whether the coal slurry market develops, it is just one of many new areas for industrial surfactants that suppliers are investigating. As one marketer puts it, "We are all looking for new and better products, with shifts from one product to another, for new and better end uses."

Some suppliers firmly believe that industrial markets offer the opportunity for providing specialty products that can offer better profits than from household-detergent sales. The major emphasis is on product development, working with people who have problems. That means committed technical service and backup R&D.

The market is fragmented, no doubt, but at least one supplier believes that that is an advantage. "We want to make special blends of surfactants—specific combinations—to do a specific job. We've a lot of products and a lot of customers."

The industrial surfactants business, in fact, may be fortunate to not have the large, concentrated customers that the household detergent business has. "If you lose one big customer, you're out of business, there," argues one supplier. Even if the several-drumload customer must be serviced by distributors, with backup provided by the surfactant supplier, the opportunities for developing those small customers to larger ones are what give the industrial surfactants business the excitement of growth and profits. □

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